

REMARKS

The subject invention relates to the measurement of overlay registration during semiconductor processing. Historically, overlay registration was measured using an optical microscope focusing on the alignment of optical targets (e.g. box in box). As geometries have shrunk, certain techniques based on diffraction measurements have been investigated. In these techniques, the targets consist of a pair of gratings, one grating formed in the lower layer and another grating formed on the upper layer. By monitoring light diffracted from the targets, the amount of misregistration between the layers can be determined.

One complication with using gratings is that the diffraction signal is periodic with increasing misregistration. Thus, diffraction methods cannot distinguish overlay errors that differ by an integer number of periods. Accordingly, errors can arise if the overlay misregistration is based solely on a diffraction measurement since it cannot preclude the possibility that a much larger, gross overlay error exists.

The method of the subject invention overcomes this problem by taking two measurements. For example, and as set forth in claim 1, a first measurement is made of the gross overlay using an optical microscope. A second measurement of overlay is obtained with a diffraction based technique. A total overlay measurement is then determined based on the two measurements.

The subject application discloses a few types of overlay targets which would be useful in the subject invention. For example, Figure 6 discloses a target consisting of a pair of overlying gratings. Grating pair 110X is arranged so that the overall dimension in the Y direction for one of the two gratings is larger than the Y dimension of the other grating. As can be seen, this means there are two regions (Y_1 and Y_2) where the gratings do not overlap. Measurement of the width of these regions Y_1 and Y_2 with an optical microscope (rather than a diffraction measurement) will provide information about gross overlay in the Y dimension. Grating pair 110Y is similar to grating pair 110X except that one grating is shorter in the X dimension than the other grating in the pair. Measurement of the width of regions X_1 and X_2 with an optical microscope will provide information about gross overlay in the X dimension. In the embodiment shown in Figure 6, one grating is shorter than the other grating in the pair in both the X and Y dimensions.

Turning to the Office Action, the Examiner raised certain objection to the claims. Applicants have amended the claims based on the helpful suggestions of the Examiner. It is believed that these objections can now be withdrawn.

In the Office Action, the Examiner indicated that all of the claims (1 to 6 and 13 to 22) directed to the **method** of the subject invention contained allowable subject matter. The only prior art rejection raised by the Examiner concerned **apparatus** claims 7 to 12 which relate to the preferred grating target structure. Applicants have amended claim 7 to more clearly identify the differences between the invention and the prior art. More specifically, claim 7 now makes it clear that at least one of the gratings in the pair has a total width dimension X or total length dimension Y that is different from the other grating in the pair an amount sufficient to facilitate measurement of gross overlay by an optical microscope. This limitation corresponds to the structures shown in Figures 5 and 6, discussed above.

In the Office Action, the Examiner rejected claims 7, 10, 11 and 12 based on the patent application to Brill (WO/02/25723). Brill teaches performing overlay metrology by measuring diffraction from a grating pair. As noted by the Examiner, the width of the lines in the top grating can be different than the width of the lines in the bottom grating. Claim 7 has been amended so that it should now be clear that applicants' invention relates to having the overall size of one grating, in either the X or Y dimension, be different from the other grating. Applicants' invention is not directed to different line widths within the grating itself. Brill does not disclose that the overall width or length of one grating should be different than the other grating in the pair. In view of the amendment to claim 7, it is believed that the Examiner's rejection under Brill should be withdrawn.

In the Office Action, the Examiner rejected claims 7 to 9 based on the commonly owned Sezginer application (WO 02/065545). The Examiner points to the structure of Figure 22 of Sezginer and the text at page 35, lines 10 to 25. Figure 22 relates to a two-dimensional "grating." Rather than using lines, two dimensional diffracting features are used. In Figure 22, the bottom layer of the grating includes a plurality of rectangular elements as the diffracting features. The top layer includes a plurality of incomplete rectangles (each having a U-shaped cut-out). The overlapping rectangular elements provide asymmetry in two axes. It should be noted that the rectangles shown in Figure 22 are individual elements within the confines of the grating. The repeating pattern of rectangles creates the diffraction effects to be measured.


Sezginer has no disclosure that the overall width or length of one grating (the large square of Figure 22, surrounding the rectangles) should be different than the other grating in the pair. In view of the amendment to claim 7, it is believed that the Examiner's rejection under Sezginer should be withdrawn.

Based on the above, it is believed that all of the pending claims are now in condition for allowance and early action is respectfully requested.

Respectfully submitted,

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